

THE TRILOBITE GENUS *AUSTRALOSUTURA* FROM THE OSAGEAN OF OKLAHOMADAVID K. BREZINSKI¹

Research Associate, Section of Invertebrate Paleontology

ABSTRACT

Trilobite specimens collected from the St. Joe Member of the Boone Formation (Osagean, Tournaisian) of northeastern Oklahoma are assigned to *Australosutura elegans* (Girty). The trilobites occur within biohermal strata which were deposited along the margin of the Burlington shelf. A review of other North American Mississippian occurrences of *Australosutura* suggests that this genus was most prevalent in shelf margin, offshelf, ramp, and basinal environments. Consequently, *Australosutura* and other trilobite species with which it is commonly associated typify relatively deep water deposits.

INTRODUCTION

Although trilobites are common inhabitants of carbonate buildups of the Lower and Middle Paleozoic (Mikulic, 1981) their documentation within Carboniferous reefs is less well known. Wolfenden (1958), Tilsley (1977), and Owens (1986) have noted numerous Carboniferous trilobite species associated with British reef facies. Lower Carboniferous reef facies of North America are moderately well known (Lane, 1982), yet no such discussion regarding trilobites from these facies has been published. The purpose of this paper is to discuss such an occurrence from a locality in the Lower Mississippian Boone Formation, near Kenwood, Oklahoma.

Trilobites were initially collected from this locality by Dr. J. L. Carter and Mr. A. Kollar of The Carnegie Museum of Natural History. More recently, I had the opportunity to collect further from this locality and was able to enlarge the trilobite collection, thus allowing more definitive taxonomic assignment of the most abundant trilobite taxon present. All but one of the specimens collected can be assigned to the genus *Australosutura*. The presence of *Australosutura* within these deposits has paleozoogeographical implications which previously have not been noted for trilobites of the Carboniferous.

Terminology utilized in this paper conforms to that outlined by Harrington (1959), and Richter and Richter (1949). All specimens of *Australosutura* collected for this study are deposited in the Section of Invertebrate Fossils of The Carnegie Museum of Natural History (CM), in Pittsburgh, Pennsylvania.

KENWOOD BIOHERM

Harbaugh (1957) discussed numerous examples of biohermal complexes from the St. Joe Member of the Boone Formation (Osagean) of northeastern Oklahoma. One of these (Harbaugh's locality number 1) is located approximately 3 km west of the town of Kenwood along the north side of Salina Creek and adjacent Oklahoma Route 20. A small quarry at the western end of the outcrop has exposed

¹ Current address: Maryland Geological Survey, 2300 St. Paul Street, Baltimore, MD 21218.
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portions of the core and adjacent flank beds. It is from this quarry that the trilobites were collected.

The flank beds consist of moderately well-sorted, medium-bedded, medium-grained, crinoidal grainstone in which crinoid ossicles are graded and abraded. However, the core is composed of unbedded, very coarse-grained, crinoidal grainstone. Crinoid ossicles within the core are largely unfragmented, unabraded, and exhibit no signs of current reworking. That this environment must have been quite favorable to its inhabitants is indicated by the large size commonly attained by crinoid and brachiopod faunal components.

Lane (1982) outlined the paleogeographic distribution of Lower Mississippian Waulsortian bioherms of North America. Some of the more prominent occurrences include: the Lake Valley Formation of the Sacramento Mountains, New Mexico; the Lodgepole Formation of Montana; the Fort Payne Formation of Tennessee and Kentucky; as well as the St. Joe Member of the Boone Formation of southwest Missouri and northeast Oklahoma. These occurrences are all located along shelf edges where platform carbonates pass seaward into deeper water deposits (Lane, 1982). Waulsortian biohermal cores typically are composed of monotonously unfossiliferous lime mudstones. In this respect the Kenwood bioherm is different from classic Waulsortian buildups (Wilson, 1975). The unbedded encrinites near Kenwood contain almost no lime mud and are highly fossiliferous.

PALEOZOOGEOGRAPHICAL DISTRIBUTION OF NORTH AMERICAN *AUSTRALOSUTURA* SPECIES

Most occurrences of the trilobite genus *Australosutura* in North America have been from rocks of Osagean age. Kammer (1985) noted the presence of *Brachymetopus spinosus* (now known to be *Australosutura lodiensis*) from the New Providence Shale of Kentucky and Indiana. Rich (1966) described the species *A. georgiana* from the Lavender Shale member of the Fort Payne Formation of Georgia. McKinney (1978) noted the presence of *A. georgiana* from the Fort Payne Chert of Alabama. Brezinski (1988c) discussed the distribution of *A. lodiensis* (Meek) from the Waverly Group of eastern Ohio, and Girty (1915) described *Brachymetopus? elegans* from the Boone Formation of Arkansas (herein assigned to *Australosutura*). Other known occurrences of North American *Australosutura* are *A. aff. A. gardneri* from the Morefield Formation (Meramecian/Chesterian) of northeastern Oklahoma (Ormiston, 1966), two species in the Louisiana Limestone (uppermost Devonian) of northeastern Missouri (Williams, 1943), and *A. gemmaea* in the Onandaga, Hamilton, and Tully formations (Middle Devonian) of New York (Scatterday, 1986).

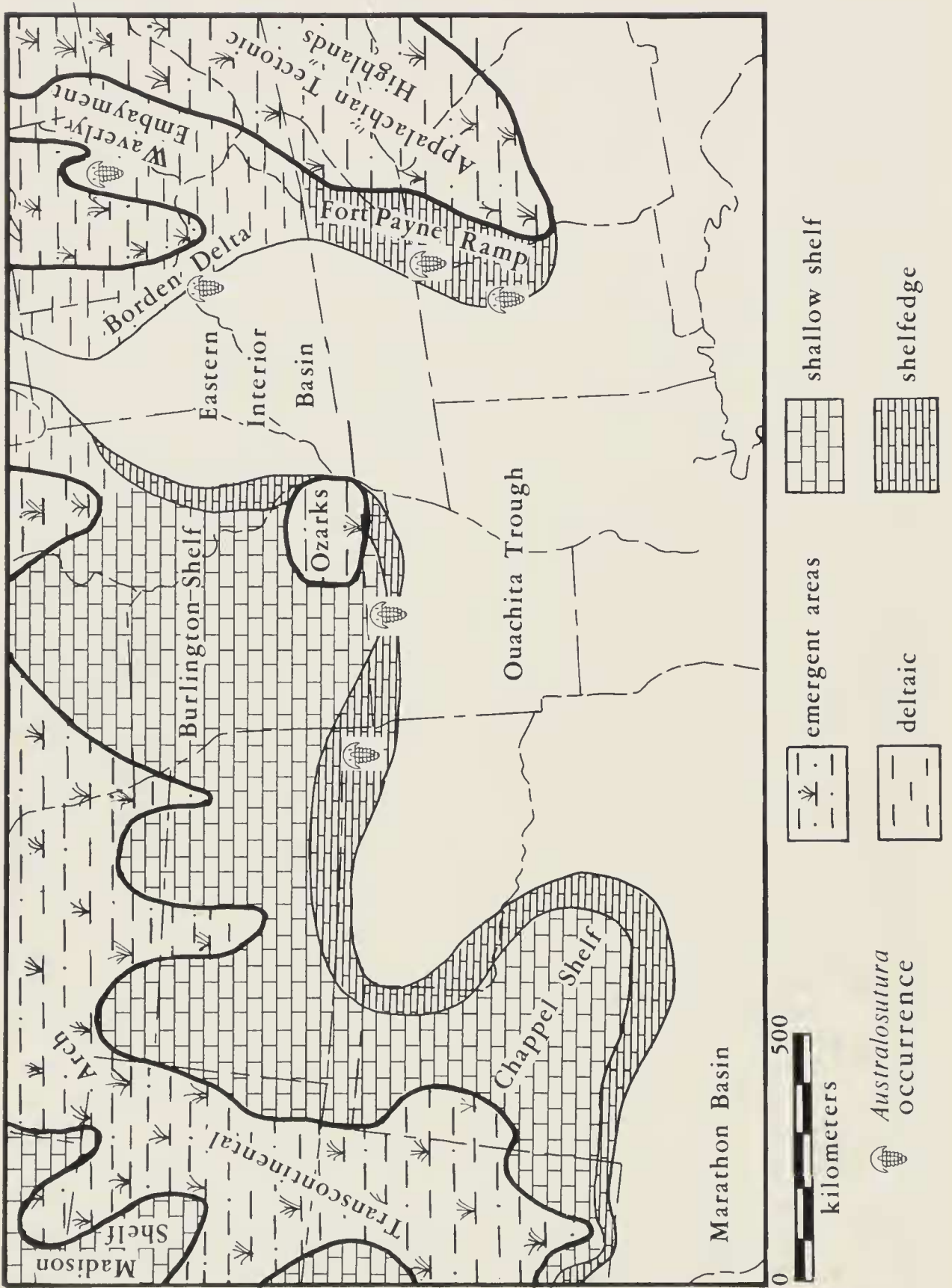
The distribution of Osagean species of *Australosutura* appears to be constrained, to a large degree, by depositional environments and paleogeography. Lumsden (1988) interpreted the Fort Payne Formation of Tennessee as having formed in a dysaerobic carbonate ramp setting. Gutshick and Sandberg (1983) also interpreted the Fort Payne as a relatively deep water ramp deposit which was bordered on the northwest by the Illinois Basin and on the west by the Ouachita Trough. The New Providence Shale was interpreted by Kammer (1985) and Kammer et al. (1986) as having formed in a dysaerobic prodeltaic-to-basinal environment. Specimens of *Australosutura* known from the Waverly Group of Ohio were also recovered from prodeltaic environments, although probably not of the depth of the New Providence Shale (Brezinski, 1988c). Although the Kenwood occurrence

of *Australosutura* is within lime grainstones whose origin was presumably of shallow to moderate water depth, Lane (1978) has shown that this location was situated at the Burlington shelf margin with deeper waters of the Ouachita Trough immediately to the south and southwest. Consequently, the distribution of *Australosutura* in Lower Mississippian strata of North America reflects the preference of this genus for shelf margin and deep water offshore, prodeltaic, and basinal environments (Fig. 1).

Other contemporaneous trilobites which may have preferred such environmental settings include: *Proetus* (*Pudoproetus*), and *Phillibole*. Species of *Proetus* (*Pudoproetus*) are known to occur with *Australosutura* within the Fort Payne Formation of Georgia (Rich, 1966), and Alabama (McKinney, 1978), the Cuyahoga Formation of the Waverly Group in Ohio (Brezinski, 1988c), and the Louisiana Limestone of Missouri (Williams, 1943). These four occurrences indicate that ecological constraints governed the distribution of these species. Moreover, neither of these genera are present, to any significant degree, within the relatively diverse trilobite faunas recognized as inhabiting carbonate shelf environments during the early Mississippian in North America (Hessler, 1963, 1965; Brezinski, 1986, 1988a, 1988b). *Phillibole*, which is locally present within basinal facies of the New Providence Shale (Kammer et al., 1986), has been well documented from the "Kulm" facies of Europe (Richter and Richter, 1949). Consequently, *Australosutura* and commonly associated genera *Proetus* (*Pudoproetus*), and more rarely *Phillibole*, typically preferred offshore, predominately detritus-dominated environments, and less commonly prodeltaic and shelf edge settings.

Inasmuch as *Australosutura* commonly existed in deep water oceanic environments, one might expect this genus to exhibit a cosmopolitan distribution. *Australosutura* is known, outside of North America, from the Visean of Argentina (Amos et al., 1960), and the Tournaisian and Westphalian of Australia (Amos et al., 1960; Campbell and Engel, 1963), and a probable representative of this genus occurs in the Siegenian or Emsian of Bolivia (Eldredge and Ormiston, 1979). According to Scotese et al. (1979), and Eldredge and Ormiston (1979) both South America and Australia were located at mid- to high-latitudes during the known temporal range of *Australosutura*. Ross and Ross (1985: Fig. 1) postulated that foraminiferans and bryozoans recovered from these continents were indicative of cold waters. Thus, trilobites from these areas must have been able to inhabit cold waters.

The distribution of *Australosutura* in the Mississippian may be analogous to that observed for Holocene isopods and interpreted for Cambrian trilobites by Taylor and Forester (1979). Taylor and Forester found that deep water, low latitude faunas were more similar to high latitude faunas than they were to low latitude, shallow water faunas. From this they concluded that thermal stratification of oceanic waters governed the distribution of taxa. Consequently, shallow water forms tend to be endemic, whereas deep water forms tend to be more pandemic in their distribution. For the Lower Mississippian, such a shelf-offshelf segregation of trilobite taxa is evident. North American Lower Mississippian trilobites which inhabited equatorial environments exhibit a strong provincialism (Brezinski, 1987, 1988b) while offshore forms such as *Australosutura*, *Proetus* (*Pudoproetus*), and *Phillibole* are much more geographically widespread. Chulpac (1966) and Hahn and Hahn (1988) identified a similar lithologic (i.e. environmental) segregation of Upper Devonian and Lower Carboniferous trilobites from the Moravian Karst



and Lower Carboniferous trilobites of Belgium, respectively. Consequently, Tethyan shelf trilobites exhibit a recognizable provincialism during the Carboniferous, whereas oceanic ("goniatite facies") trilobites are to a large degree cosmopolitan.

SYSTEMATIC PALEONTOLOGY

Family Brachymetopidae Prantl and Pribyl, 1950

Genus *Australosutura* Amos, Campbell, and Goldring 1960

Australosutura elegans (Girty, 1915)

Fig. 2A–H; 3A–E, I–K

Brachymetopus? elegans Girty, p. 22–23, pl. II, Fig. 6; Hahn and Hahn, 1969, p. 21.

Neotype.—A pygidium from the Boone Formation from St. Joe, Arkansas, USNM 121126.

Material.—1 complete cephalon, CM 35557, 1 partial cephalon, CM 35559, 7 complete and 7 fragmentary pygidia CM 35558, 35560, 35562–35564, from the St. Joe Member of the Boone Formation 3 km west of Kenwood, Mayes County, Oklahoma.

Description.—Cephalon semicircular in outline. Glabella 0.43 of the total cranidial length, tapering forward, rounded anteriorly, subtrapezoidal in outline, of slight to moderate vaulting, and exhibiting small, poorly defined granules. Frontal lobe relatively smooth, lacking lateral inflation, rising gently from frontal area, sides nearly vertical. Poorly defined 2p furrow, marked by shallow inflection of dorsal furrow. Broad 1p, shallow, narrowing and deepening anteriorly into dorsal furrow. Lateral glabellar lobes suboval in outline. Occipital furrow sinuous, broad, and shallow, deepening and narrowing immediately posterior of the lateral glabellar lobes. Occipital lobe narrow, moderately arched (transverse), and rounded in longitudinal profile, marking the highest point on the cephalon. Dorsal furrow sinuous, deepest between the eyes. Palpebral lobes small, crescentic, inclined into dorsal furrow. Preglabellar field slightly convex immediately anterior and anteriolateral to the glabella, becoming slightly concave, less steeply inclined to the margin. Convex portion of the field exhibiting coarse granules, concave portion displaying small pits which demarcate broad border furrow. Margin acutely rounded and flattened anteriorly. Facial sutures sinuous and diverging strongly from γ to β , broadly rounded at β , sharply recurved at γ , straight and diverging posteriorly from ω to ζ . Eyes small, hemispherical, intersecting concave lateral field vertically. Lateral border furrows more distinct than anterior border furrow, deepest where it intersects posterior border furrow. Genal spine of moderate length, tapering sharply posteriorly. Thorax is not known.

Pygidium parabolic in outline, moderately to highly vaulted, 0.80 times as long as wide. Axis strongly tapering posteriorly to sharply rounded terminus, composed of 13 to 14 rings, 0.36 of the maximum anterior pygidial width, and 0.83 to 0.85 the total pygidial length. Rings subsemicircular in transverse profile, ornamented with 3 pustules the largest of which is located at the apex of each ring. Ring furrows sinuous, moderately wide, deeply incised at the dorsal furrow. Pleural field strongly convex (transverse), composed of 9 ribs ornamented with 2 pustules. Pleural furrows narrow, becoming broader posteriorly, extending posteriorly to the margin. Interpleural furrows well-developed anteriorly becoming faint, nearly obscure to the posterior. Ribs extend slightly beyond margin to form short marginal spines.

Remarks.—Scatterday (1986) outlined the stratigraphic distribution and relationships between North American Devonian and Mississippian brachymetopid trilobites, especially *Australosutura*. However, he (Scatterday, personal commu-

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Fig. 1.—Distribution of Osagean occurrences of the trilobite genus *Australosutura* in North America and their relation to paleogeography and depositional environment. Paleogeography reconstruction from Lane (1978) and Gutshick and Sandberg (1983).

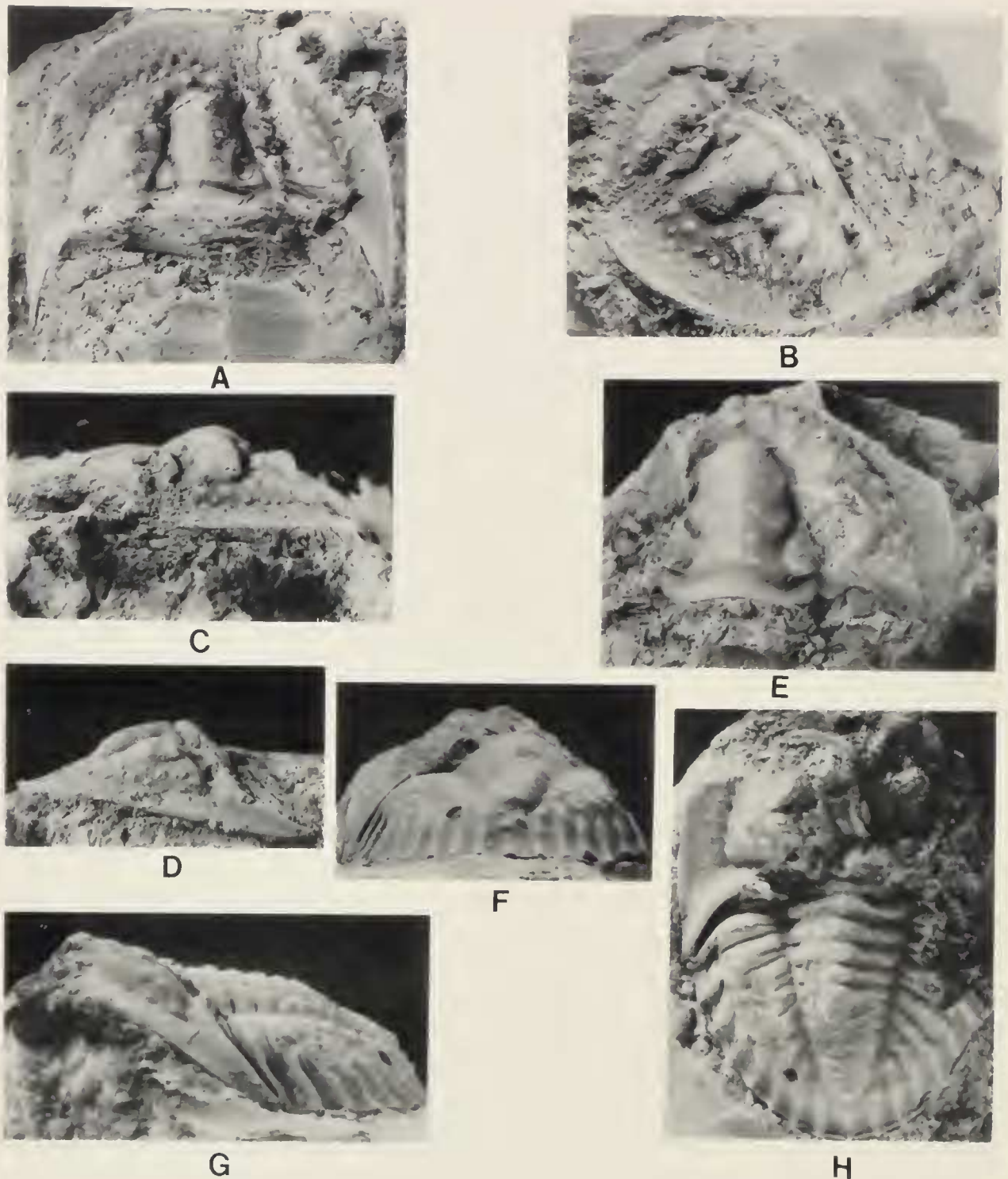


Fig. 2.—*Australosutura elegans* (Girty). A–D, dorsal, oblique, anterior, and lateral views of nearly complete unexfoliated cephalon, CM 35557, $\times 5$; E, dorsal view of incomplete cephalon, CM 35559, $\times 4.5$; F–H, posterior, lateral, and dorsal views of unexfoliated pygidium and partial librigenae, CM 35558, $\times 4.0$.

nication) did not assign *Brachymetopus? elegans* Girty to *Australosutura*, because he had not examined the type specimen. The neotype of *Brachymetopus? elegans* Girty from the Boone Formation at St. Joe, Arkansas, housed at the U.S. National Museum is identical to pygidia of *Australosutura* collected from the Kenwood bioherm (Fig. 3). All pygidial ratios and characters are the same, indicating that these specimens belong to the same species.

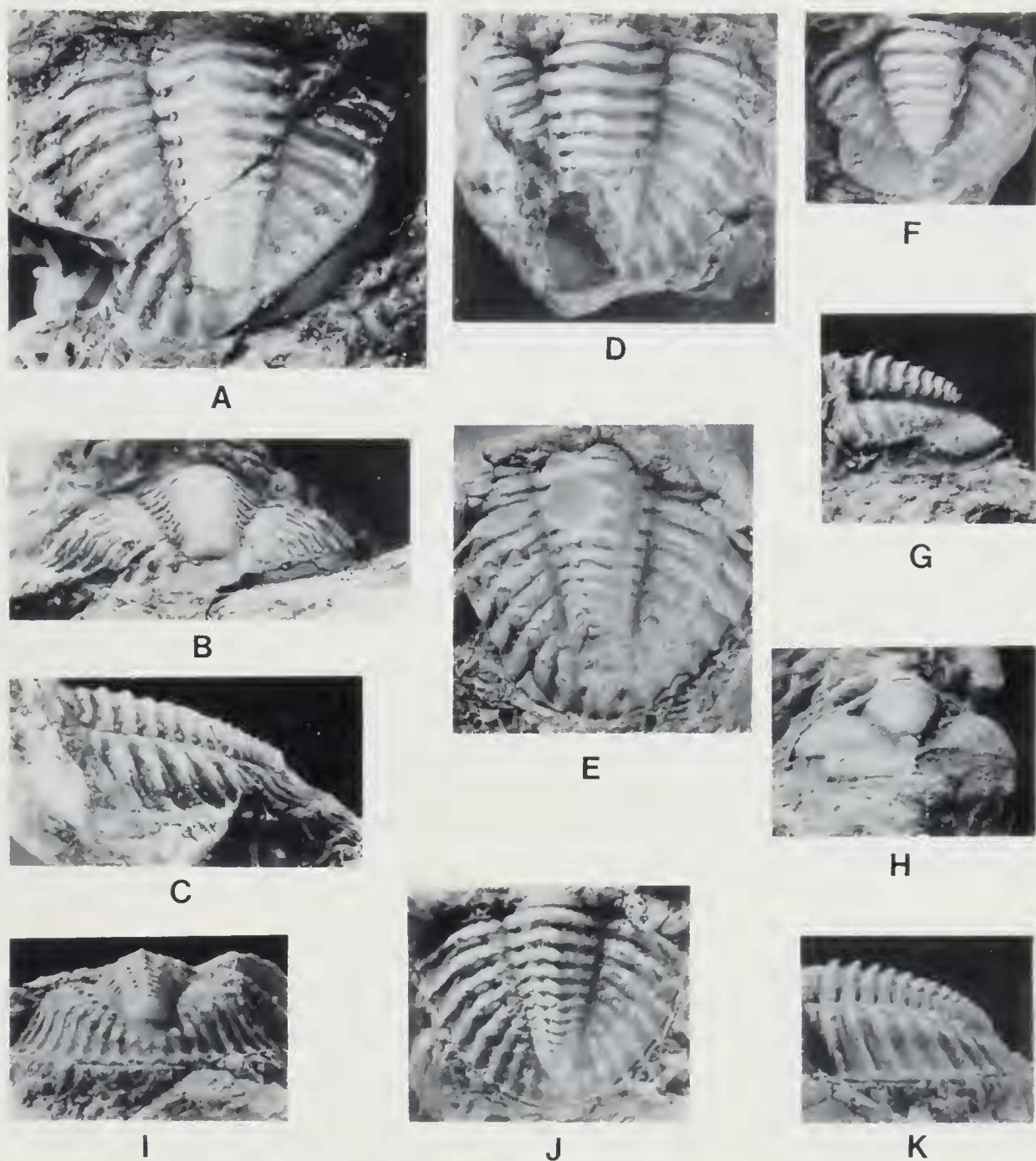


Fig. 3.—*Australosutura elegans* (Girty). A–C, dorsal, posterior, and lateral views of neotype pygidium, USNM 121126; D, dorsal view of partial pygidium, CM 35560, $\times 3.5$; E, dorsal view of nearly complete, unexfoliated pygidium, CM 35562, $\times 3.5$; I–K, posterior, dorsal, and lateral views of complete, unexfoliated pygidium, CM 35563, $\times 3.5$. Genus and species undetermined. F–H, dorsal, lateral, and posterior views of partial pygidium, CM 35561, $\times 8$.

Australosutura elegans (Girty) can be distinguished from *A. lodiensis* (Meek) by the greater vaulting, more deeply incised dorsal furrow, better-developed lateral and posterior border furrows, coarser and more abundant cephalic ornament, and upturned anterior margin in the latter species. *Australosutura georgiana* Rich differs from *A. elegans* by the relatively longer glabella which exhibits a more rounded frontal lobe, more sinuous dorsal furrow, and better defined preglabellar furrow on *A. georgiana*. The material of *A. georgiana* illustrated by Rich (1966)

exhibits a somewhat coarser ornament to the fixed and free cheeks than does *A. elegans*. Inasmuch as *A. georgiana* was recovered from shale, compaction of the cephalon and pygidia precludes further discussions regarding differences between these two species. The cephalon of *A. aff. A. gardneri* from the Morefield Formation of Oklahoma illustrated by Ormiston (1966) is very similar to *A. elegans* from the Kenwood locality except that *A. aff. A. gardneri* appears to exhibit coarser, more abundant cephalic surface ornamentation and greater vaulting to the posterior terminus of the pygidium. *Australosutura stratton-porteri* (Williams) appears to exhibit an upturned anterior cephalic margin, longer genal spines, and more abundant surface ornamentation than does *A. elegans*. Greater cephalic vaulting and ornamentation, glabellar inflation, a longer genal spine, more abundant pygidial ornamentation (including posterior to the axial terminus) serve to distinguish *A. argentinensis* Hahn and Hahn, and *A. gardneri* Amos, Campbell and Goldring from *A. elegans*.

Genus and Species undetermined

Fig. 3F–H

Material.—1 pygidium from the St. Joe Member of the Boone Formation, 3 km west of Kenwood, Mayes County, Oklahoma, CM 35561.

Description.—Pygidium semicircular in outline. Axis of moderate vaulting, composed of 8 rings, semicircular in transverse profile, 0.25 of the maximum anterior pygidial width, and 0.71 of the maximum pygidial length. Pleural fields of moderate convexity, composed of 6 ribs. Border broad and downsloping to margin.

Remarks.—This single small pygidium is too poorly preserved to make a definitive identification. The well-defined border, convexity of the pleural fields, and outline are similar to that illustrated for *Thigiffides depressus* (Girty) by Hessler (1965: plate 38, fig. 7, 8, 11).

CONCLUSIONS

In North America the genus *Australosutura*, and other trilobite genera with which it is associated, typically occur in deposits of deep water origin. Such environments include shelf edge, prodeltaic, and carbonate ramp. Outside of the North American Mississippian, occurrences of *Australosutura* are known from high-latitude shelf deposits of the southern hemisphere. This reflects the preference of this genus for cold, oceanic waters.

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